

Attorney Docket No.:F3319(C)  
Serial No.:10/678,461  
Filed: October 3, 2003  
Confirmation No.: 3331

## **REMARKS**

### ***Amendments to the Claims***

Claim 1 has been amended without prejudice to recite preferred embodiments of applications invention that are more clearly differentiated from the prior art. Specifically:

The preamble to the claim has been amended to recite the key advantages of applicants' process, namely the production of frozen fruits that when eaten frozen better retain the flavor and structure of unfrozen fruit as disclosed on page 1, lines 20-23 and page 2, lines 13-18.

Step 1 of the method now specifies that the under-cooling (i.e., reducing temperature without the formation of ice crystals) is carried out from 0 C to at least 5 C below the freezing point and that the cooling rate employed during under-cooling (which can be between 2 C/hr and 320 C/hr) must provide a temperature difference between the core and surface of the fruit that is less than 1.5 C. Support is provided in original claim 3 and page 4, lines 31-33 and discussed in examples 4 to 6 on page 7, line 32 to page 8, line 2.

Claim 3 is hereby canceled.

***Claims Rejection under 35 USC §103***

In the Final Office Action mailed November 27, 2007, claims 1, 3-5 and 13-14 were rejected under 35 U.S.C. 103(a) as being unpatentable over Yamane et al (EP0,815,746) in view of Desrosier et al (Fundamentals of Food Freezing) and Jay (Modern Food Microbiology). Applicants respectfully request the Examiner to reconsider this rejection in light of the above amendments and the following remarks.

Yamane et al discloses "a method of preserving perishable foods or the like, in a nonfrozen state below the freezing point of the food or the like, which comprises comparatively rapidly cooling the same from ordinary temperature to the vicinity of the freezing point of the same and then slowly cooling the same below the freezing point at a cooling rate of 0.01-0.5 C/h, and this method permits perishables such as vegetables, fruits, fishes or shellfishes to be preserved with a high degree of freshness....." (Abstract).

Yamane teaches many different embodiments of the method. One of these is a "slow cooling treatment, which is carried out at a gradual cooling rate of 0.01 to 0.5 C/hour, can be combined with a rapid freezing treatment, in which the food or the like is frozen to - 18 C or lower ..... " (Page 9, lines 3-4)

All the embodiments that deal with cooling include the same common element, namely, rapidly cooling the food to a temperature "in the vicinity of " or "close to" or "below" the freezing point and then "slowly" or "gradually" cooling the food at a cooling rate of 0.01-0.5 C/h "below the freezing point" or "to below the freezing point".

Thus, regardless of the embodiment, the Yamane method requires that at some temperature in the "vicinity of" (including above), "at", or "below" the freezing point of the food, the food must experience a cooling rate of 0.01-0.5 C/hour. Yamane states this requirement clearly on page 5, lines 6-10: *"when a slow cooling treatment involving cooling at a gradual rate of 0.01° to 0.5° C/hour to below the freezing point is not performed, it is difficult to maintain a food or the like in a non-frozen state in the temperature zone below the freezing point, and the stated objects cannot be achieved."*

Desrosier et al in Fundamentals of Food Freezing is cited by the Examiner for its disclosure that "great advances have been made in the techniques of freezing fruit rapidly. The present individually quick-frozen (IQF) and cryogenic frozen fruits are superior in quality and stand up better to thawing than the fruits frozen slowly in packages cartons or bulk containers" (p48).

Jay, in "Modern Food Microbiology" (cited by the Examiner), defines on page 325 quick or fast cooling as "a process by which the temperature of foods is lowered to about – 20° C within 30 minutes." According to Jay this treatment may be achieved through the use of air blasts of frigid air blown across the food being frozen", e.g., through the use of a blast freezer.

In contrast, applicants' claims are directed to a different technical problem of the production of frozen fruits which when eaten frozen better retain the flavor and structure of unfrozen fruit (page 1, lines 20-23 and page 2, lines 13-18). Applicants' have discovered that these improvements in flavor and texture are achieved by i) under-cooling the fruits from 0 C to a temperature that is at least 5 C below the freezing point

of the fruit (in the range of -6 to -15 C); and ii) employing during under-cooling a cooling rate that maintains a temperature differential between the surface and the core of fruit which is less than 1.5° C (the chosen rate being between 2° C/hr and 320° C/hr).

Applicants have stated in the background to the invention that a process that "requires a very slow cooling rate" [referring specifically 0.01° to 0.5° C/hour – see page 1] "renders it incompatible with any industrial application". Applicants further state that their process "can be operated at a cooling rate fully compatible with industrial processes". Thus, applicants specifically exclude a cooling rate falling in the range of 0.01° to 0.5° C/hour during under-cooling.

The Examiner asserted in the final Office Action that "since Yamane discloses combination of rapid cooling with slow cooling and that any method may be employed to subject the food or the like to a cooling treatment in a temperature zone in the non-freezing region below the freezing point, and Desrosier discloses the advantages of quick cooling/freezing techniques, it would have been obvious to modify disclosure of Yamane and to vary the cooling rates in order to achieve high levels of freshness and quality as disclosed by Yamane. One of ordinary skill in the art would have been motivated to do so in order to obtain superior quality product as taught by Desrosier."

The Examiner goes on to assert that "Such a cooling rate is in the claimed range as evidenced by Jay. As evidenced by Francis et al.... the freezing rate may be evaluated by the speed of movement of the ice (in centimeters per hour) through the product. This speed is faster near the surface and slower towards the center". Thus "employing method steps as taught by Yamane et al and cooling rate as taught by

Desrosier et al for the reasons set forth above, would inherently lead to a temperature difference between the surface and core and a fracture force as a measurement of mechanical properties of food in relation to texture as claimed."

Applicants respectfully submit for the reasons set forth below that the Examiner's analysis is incorrect.

Firstly, regarding the Examiner's interpretation of Yamane disclosure of the combination of rapid cooling with slow cooling, Yamane states on page 4, lines 54-57 in pertinent part (emphasis added)

*any method may be employed to subject the food or the like to a cooling treatment in a temperature zone in the non-freezing region below the freezing point as long as a relatively rapid cooling treatment can be carried out in a low-temperature region below 0 C, and as long as a slow cooling treatment to below the freezing point at 0.01 to 0.5 C/hour and preferably 0.01 to 0.4 C/hour can be carried out .....*

As discussed above, applicants implicitly exclude a cooling rate in the range of 0.01 to 0.5 C/hour during under-cooling.

Since Yamane teaches a combination of a rapid cooling rate from 0 C to some temperature above the freezing point of the fruit and a slow cooling rate from some temperature above the freezing point of the fruit to some temperature below the freezing point of the fruit, the Examiner concluded that the "overall cooling rate would be greater

than 0.5 C/hour implying that Yamane et al would not preclude applicants recited cooling rates over the range from 0 C to at least 5 C below the freezing point.

Applicants' claims recite a cooling "rate" and not an "overall" or "average" cooling rate. The term cooling rate, as it is commonly employed, refers to the slope of the temperature Vs time cooling curve, i.e., the rate of change of the temperature with time measured at each time point. Cooling rate is an instantaneous rate of change of temperature with time just as speed is the instantaneous rate of change of velocity with time. The Examiners "reinterpretation" of Yamane would be analogous to explaining to a traffic patrolman that the car was not traveling 85 miles an hour in a 50 mile per hour zone because over the last hour the car only traveled 40 miles. Applicants cooling rate is analogous to the "speed of the car" and not to how long it took to drive a given number of miles.

In point of fact, over a temperature range that is vaguely described by Yamane as encompassing a low-temperature region below 0 C to below the freezing point, applicants employ a cooling rate which is at least 5 times higher than the maximum cooling rate required by Yamane in this temperature range and stated by Yamane to be absolutely essential to the functioning of the invention for its intended objective.

Turning now to the Examiners assertion of the obviousness of combining Desrosier with Yamane because "Desrosier discloses the advantages of quick cooling/freezing techniques". Applicants submit that the Desrosier disclosure is not consistent about the benefits of quick freezing when the article is read on its entirety. Several passages from Desrosier quoted below demonstrate this ambiguity:

"As mentioned earlier, the effects of rate of freezing on quality of fruits are controversial. So called "quick freezing was developed more for freezing vegetables than fruits, because in general there is more benefit for vegetables." Page 147, last paragraph "There are reported no marked differences in texture, microscopic appearance, or palatability of strawberries, raspberries, and peaches packed in syrup, whether they were frozen slowly or rapidly". Page 148 middle second paragraph

"Data indicate no difference in the condition of apple and cherry pie fillings when they were frozen slowly (14 hr.) or "rapidly" (2 hr.)" Page 148 middle second paragraph

"Very rapid freezing in liquid nitrogen has been found beneficial to texture of strawberries and sliced tomatoes..... This beneficial effect occurs only in a few fruits, even at the rapid freezing rate attained with liquid nitrogen, which is another indication that there is little distinction in effect on quality between fruits "slow-frozen" or "quick-frozen" at the usual temperatures"

Applicants submit that a person of ordinary skill in the art reading Desrosier in its entirety may well have been dissuaded from tinkering with the ultra-slow cooling rate of Yamane which was shown to be essential for achieving better quality frozen fruits because Desrosier teaches that quick freezing provides advantages in quality only in a limited number of cases.

Neither Yamane, Desrosier or Jay individually or collectively, explicitly or implicitly discloses any limitations on cooling rate let alone a limitation connected in any way to the heat transfer properties of the fruit, i.e., that the temperature differential between surface

and core must be  $<1.5\text{ C}$ . Neither do the references disclose under-cooling to any specific temperature let alone under-cooling to a temperature at least  $5\text{ C}$  below the freezing point of the fruit (in the range from  $0\text{ C}$  to  $-6\text{ C}$  to  $-15\text{ C}$  ).

The Examiner has dismissed the limitation on cooling rate discovered by applicants and its associated effects on mechanical properties (claim 16) with the comment "thus employing method steps as taught by Yamane et al and cooling rate as taught by Desrosier et al ..... would inherently lead to a temperature difference between the surface and core and a fracture force as a measurement of mechanical properties of food in relation to texture as claimed".

Applicants have found that one key to obtaining frozen fruits that are more flavorful and softer when eaten in the frozen state was the selection of a cooling rate that provides both under-cooling to a temperature at least  $5\text{ C}$  below the freezing point and a temperature differential between the surface and core of the fruit of less than  $1.5\text{ C}$  during the under-cooling. Applicants have found that a range of cooling rates may be suitable (depending for example on dimensions, geometry and heat transfer properties of the fruit pieces, etc.). However, cooling rates within this range are only suitable when they provide both an under-cooling over the temperature regime recited (i.e., cooling to at least  $5\text{ C}$  below the freezing point without formation of ice crystals) and when the cooling rate achieves a temperature differential  $<1.5\text{ C}$ .

Comparative examples 1-3 and Examples 4-6 which were pointed out to the Examiner in applicants response of September 18, 2007 but apparently ignored, demonstrate the surprising effects of these selection criticalities compared with the prior art.



In comparative Examples 1-3, mango, kiwi and strawberries were frozen "in a blast freezer from ambient temperature to  $-30^{\circ}\text{C}$  within one hour". Assuming ambient temperature is about  $20^{\circ}\text{C}$ , this procedure, corresponds to an "overall" or "average" cooling rate" of 55 in one hour. If the cooling rate in the blast freezer indeed remained sensibly constant then the average cooling rate would equal the instantaneous (normal) cooling rate over the entire temperature range. Thus, in this case the cooling rate would be within the range recited in claim 1 and therefore according to the Examiner meet the  $<1.5^{\circ}\text{C}$  criteria as well as provide fruits with the claimed physical properties. This conclusion would be completely incorrect.

As pointed out on page 7, lines 8-10 the fruits frozen according to above prior art procedure exhibited little under-cooling (less than  $1^{\circ}\text{C}$ ) and the temperature difference between the surface and core of the fruits during the under-cooling step was between  $1.5^{\circ}$  and  $4^{\circ}\text{C}$ . Thus, neither the range of under-cooling nor the temperature differential during under-cooling met applicants' selection criteria.

In Example 4, the same types of fruits of the same geometry were frozen from  $+10^{\circ}\text{C}$  to  $-30^{\circ}\text{C}$  in a Montford freezer at a rate of  $2.5^{\circ}\text{C}/\text{hour}$  (lines 22-24). For these types of fruit pieces, this cooling rate provided under-cooling of at least  $5^{\circ}\text{C}$  below the freezing point and a temperature differential between the surface and core of the fruits during under-cooling of less than  $1^{\circ}\text{C}$  and typically around  $0.5^{\circ}\text{C}$  (see page 7, line 24 to page 8 line 2) thus meeting the selection requirements recited in claim 1.

Surprisingly, the fruits frozen according to applicants' process (Examples 3-6) had a much stronger flavor when eaten frozen and exhibited a much lower fracture force in the frozen state (i.e., they would be expected to be easier to chew in the frozen state) compared with fruits frozen according to the comparative examples 1-3. Thus, although the comparative examples utilized a "fast cooling rate" that fell within the recited range, neither the cooling rate nor extent of cooling satisfied the limitations recited in the claim and the fruits produced were of inferior quality.

The above results are significant for two reasons. First they refute the Examiners assertion that it is only cooling rate which is important and the other limitations are inherent and inconsequential. Secondly, they are very surprising in view of the teachings of both Yamane and Desrosier.

To modify the combination of Yamane and Desrosier to arrive at applicants' invention a person of ordinary skill in the art would have had to: i) substitute the slow cooling rate of 0.01 to 0.5 C/hour (against the advice of Yamane) with a cooling rate at least 5 time higher; and ii) further ensure that the selected cooling rate is capable of simultaneously under-cooling the fruit to a temperature which is at least 5 C below the freezing point of the fruit and providing a temperature differential between surface and core which is less than 1.5 C.

Applicants' submit that it is only through hindsight that these changes could reasonably be described as "obvious" to a person of ordinary skill in the art because the required increase in the slow cooling rate is explicitly discouraged by Yamane without any definitive benefit expected from Desrosier, and because the required selection criteria for

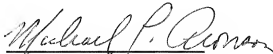
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extent of under-cooling and cooling rate are not mentioned either implicitly or explicitly in the references.

In view of the forgoing amendment and remarks, applicants respectfully request the 103(a) rejection of claims 1, 3-5 and 13-14 over Yamane et al (EP0,815,746 in view of Desrosier et al (Fundamentals of Food Freezing) and Jay (Modern Food Microbiology) be reconsidered and withdrawn and that the application be allowed to issue.

If a telephone conversation would be of assistance in advancing prosecution of the subject application, applicants' undersigned agent invites the Examiner to telephone him at the number provided.

Respectfully submitted,

A handwritten signature in cursive script, reading "Michael P. Aronson".

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